ARIZONA DEPARTMENT
OF
ENVIRONMENTAL QUALITY

Douglas A. Ducey
Governor

Misael Cabrera
Director

via e-mail

September 7, 2017
FPU18-041

Ms. Catherine Jerrard
AFCEC/CIBW
706 Hangar Road
Rome, NY 13441

RE: WAFB – ADEQ comments - *Revised Draft Final Addendum #2, Remedial Design and Remedial Action Work Plan for Operable Unit 2, Revised Groundwater Remedy, Site ST012, Former Williams Air Force Base, Mesa, Arizona*; prepared for Air Force Civil Engineer Center (AFCEC/CIBW), Lackland AFB, TX; prepared by Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec), Phoenix, AZ; document dated August 8, 2017.

Dear Ms. Jerrard:

Arizona Department of Environmental Quality (ADEQ) Federal Projects Unit (FPU) and ADEQ contractor UXO Pro, Inc. reviewed the above referenced document. ADEQ's comments are presented below and on following pages.

General Comments

GC 1: Pre-EBR (enhanced bioremediation) mass estimates in the revised draft final document are not reliable for the selection and design of enhanced bioremediation (EBR). The mass estimates presented in Table 2-1 for the Pre-SEE LNAPL and in Table 2-6 for the estimated COCs remaining Pre-EBR are not reliable for the selection and design of EBR as described in the comments and responses to responses to comments on the Amec mass estimate spreadsheet of March 23, 2017. The majority of previous comments provided by ADEQ remain applicable to Appendix A of the Revised Draft Final Addendum #2. In particular, the assumed light non-aqueous phase liquid (LNAPL) removal percentages from steam enhanced extraction (SEE) are not justified by any field data or citations to peer-reviewed literature. The removal assumptions were further compromised by the lack of measures for mass removal from individual vertical zones during SEE. The LNAPL mass and constituent fractions are the sole parameters upon which the EBR design relies for specifying the mass of sulfate to be injected. An upward revision of the mass may render the approach untenable.

GC 2: Design of EBR in the upper water bearing zone (UWBZ) is not based on any field biological data. Amec did not conduct an EBR field test in the UWBZ in support of EBR design as specified in the Final Remedial Design and Remedial Action Work Plan (Amec, 2014). The rising groundwater level did not

d. The document needs to be corrected to reflect that no direct hydrocarbon assimilation or biological degradation rates have been obtained for this site, particularly post-SEE. The only direct microbial data that has been obtained enumerates sulfate-reducing bacteria at the site (pre-SEE) via quantified polymerase chain reaction (qPCR) technology. No attempt to directly prove hydrocarbon assimilation (through stable-isotopes or other such direct methods), or to directly measure biological degradation rates, has been conducted.

3. **Section 2.5, Lines 573-588:**
   a. Provide contaminant maps and temperature gradient maps. As stated in General Comment 4, many of the reported temperatures for this site continue to be significantly above those that are optimal for soil sulfate-reducer survival.
   b. Clarify referred iron state (ferric iron, ferrous iron, etc.). Line 573 claims that elemental iron is a potential TEA, and this is not true. Repeated requests for clarifications as to what form of iron is being referred to (ferric iron, ferrous iron, etc.) have been ignored. This issue occurs throughout the document and should be corrected.
   c. Revise text to reflect that the referenced data does not reflect current site conditions. Line 585 references 18-year old site data that is no longer relevant or scientifically valid, as discussed above.
   d. Lines 587-588: Revise text to reflect that sulfate reducer hydrocarbon biodegradation and population tests have not been conducted. The same 18-year-old data is used to claim that "sulfate-reducing bacteria provide a majority of the naturally occurring assimilative capacity for hydrocarbon degradation at ST012 (BEM, 1998)". This is an erroneous statement, as the ability for hydrocarbon biodegradation, specifically tied to sulfate reducers under current site conditions, has not been tested. Furthermore, the statement that SRB's provide a "majority" of the indigenous hydrocarbon degrading population has never been tested, as no other population has been properly quantified.

4. **Section 3.1.1, Lines 630-631:** Provide evidence (peer-reviewed publications, etc.) that transitioning an aerobic site to a strongly anaerobic site, and then possibly back to aerobic conditions, is a standard procedure for in-situ bioremediation. Lines 630-631 state "Historically, aerobic biodegradation has been demonstrated at the site, especially in wells containing high concentrations of dissolved BTEX+N". If aerobic bioattenuation has been historically demonstrated, it suggests that the site's natural state is aerobic and not strongly anaerobic (such as sulfate-reducing).

5. **Section 3.1.2, Lines 658-663:**
   a. This section states that "sulfate is a TEA that is utilized by microorganisms under anaerobic conditions". This should be revised to more accurately state "sulfate is <u>one of many</u> TEA's that are utilized by microbes under anaerobic conditions". Sulfate-reduction is the only anaerobic process evaluated, despite statements in past documents that other TEAs would be evaluated to determine which is truly dominant at this location. A statement to this effect should be made in the document.
   b. The focus on anaerobic biodegradation disregards the statement in line 630 that "Historically, aerobic biodegradation has been demonstrated at the site, especially in wells containing high concentrations of dissolved BTEX+N". The document should be edited as requested in the previous comment.
   c. The document should be corrected to reflect actual data obtained. In line 663, the claim that sulfate-reduction dominates site biological activity has not been proven. Appendix D of this document clearly states that SRBs make up only 0.48-4.13% of the whole community while anaerobes as a whole make up at least 0.52 – 48.44% of the total microbial community profile.

14. **Section 4.2.6, Lines 1337-1339:** It is unclear why deliberate inhibition of microbial growth is planned as a way to prevent biofouling. This is not a standard practice, and is contrary to the goal of promoting microbial biodegradation of site contaminants. Please explain why previous suggested methods, such as injecting under pressure, were not planned to be followed.

15. **Section 5.0, Table 5.1:**
    a. PLFA analyses are not a form of stable-isotope (SIP) analyses, but are instead a molecular analysis. The document needs to be corrected to reflect this.
    b. Please include footnotes for notes 1 and 2 that appear in the first column of pages 5-3, 5-5, and 5-6, or remove the notes if they are not applicable.
    c. Add the following wells to the list of Table 5-1 Groundwater/Perimeter monitoring wells and clarify the sampling frequency in Section 5:
        i. CZ08, CZ09, CZ23, CZ25, and CZ24 (as shown on Fig 3-2)
        ii. UWBZ09, UWBZ18, UWBZ38, UWBZ39 (as shown on Figure 3-3)
        iii. LSZ52, LSZ53, LSZ54, LSZ55, LSZ56, LSZ57, LSZ59 (as shown of Figure 3-4)

16. **Section 5.1, Lines 1409-1410:** The text does not match the protocols outlined in Appendix J. Also, see Section 5.1.3, Lines 1440-1441 for another example of this contradictory text versus the Appendix J Decision Matrix. The entire document needs to be revised for consistency, as stated many times in the past and above.

17. **Section 5.4, Lines 1527-1529:** As pointed out initially in the 2016 review of the Draft EBR Work Plan Amendment 2, one month is not an appropriate amount of time for these samplers to be deployed in the subsurface if accurate results are desired. This has been confirmed by communications with Microbial Insights, the manufacturer of the samplers planned for use. Please edit the document to reflect that a scientifically appropriate length of time will be used for sampler deployments.

18. **Section 5.4, Lines 1545 -1553:**
    a. Lines 1547-1549. This statement says that "qPCR conducted on metagenomics extract will be used to detect and quantify (by gene count) the abundance of SRBs and EBAC will be the primary method used to track response." Please clarify this sentence intent.
    b. The quote goes on to say that "the qPCR will target the detection of 16S ribonucleic acid sequences unique to 1) SRBs and 2) EBAC." This is impossible, as the referenced 16S sequence is an RNA molecule, common to all bacteria, and the referenced qPCR technology targets DNA, not RNA. Please correct this statement.
    c. The document then continues to say that "it is recognized that this method excludes archaea; however, bacteria will occupy the majority of activity in the subsurface and provide a surrogate measure for archaea." This is despite repeated claims that methanogens are a key microbial component at this location, and methanogens are part of the archaea organismal group. If methanogens are as significant as claimed, why are they being excluded? This question should be addressed in the document.
    d. Finally, the document states that "in addition, protein extract consisting of PLFAs derived from cell walls will be analyzed to assess the microbial diversity." This comment highlights the belief that there is a misunderstanding of the above-discussed technology, as PLFA molecules are not proteins. PLFA's are phospholipid fatty acid monomers which, together help make the primary cell wall structure of bacteria. Dotted within this PLFA matrix are proteins, but the statement that PLFA molecules are proteins is scientifically false. This statement needs to be corrected for scientific accuracy. The entire document, with particular

Closure

ADEQ may add or amend ADEQ comments if evidence to the contrary of our understanding is discovered; if received information is determined to be inaccurate; if any condition was unknown to ADEQ at the time this document was submitted or electronically delivered; if other parties bring valid and proven concerns to our attention; or site conditions are deemed not protective of human health and the environment within the scope of this Department.

Thank you for the opportunity to comment. Should you have any questions regarding this correspondence, please contact me by phone at (602) 771-4121 or e-mail miller.wayne@azdeq.gov.

Sincerely,
Wayne Miller
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Remedial Projects Section, Waste Programs Division

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